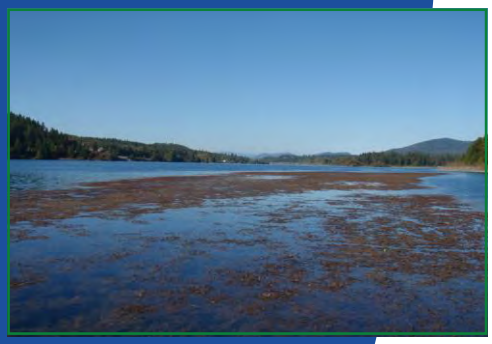
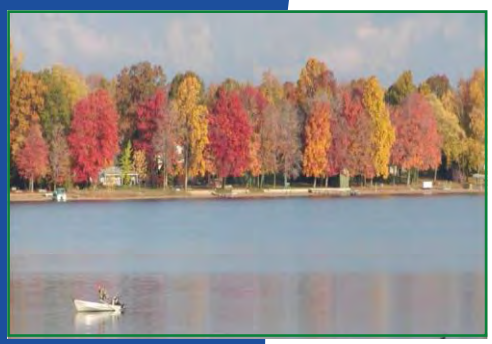
2014 Vegetation Survey and Weevil Population Survey at Les Cheneaux Islands, Lake Huron, Michigan

Prepared for:

The Les Cheneaux Watershed Council





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1.0 Introduction

At the request of the Les Cheneaux Watershed Council (LCWC), a vegetation survey was conducted throughout nine bays and channels of the Les Cheneaux Chain of Islands (LCI) from August 11 to 13, 2014 (Table 1.0, Figure 1.0). The purpose of this survey was to compile an inventory of all submersed aquatic vegetation species, identify locations of Eurasian watermilfoil (*Myriophyllum spicatum*) (EWM) infestation, and identify additional invasive/nuisance species to provide a baseline for future management practices. A milfoil weevil (*Euhrychiopsis lecontei*) population survey was also conducted in Cedarville, Sheppard's, and Smith's Bays to document the extent to which the weevils have controlled the EWM in the project areas per the requirements of the stocking contract.

Table 1.0. Summary of 2014 Survey Areas

Survey Area	Abbreviation	Vegetation Survey Type	# Survey Points	Length Between Transects or Points (ft)	2014 Survey Date
Cedarville Bay	CB	AVAS	3	500	8/11
Cedarville Bay*	CDB	PI	146	350	8/14
East LaSalle Channel+	ELS	AVAS	9	500	8/11
Hessel Harbor	HH	AVAS	1	500	8/11
Hill's Channel	HC	AVAS	7	1000	8/11
Islington Channel	IC	AVAS	13	250	8/11
Moscoe Bay	MOS	AVAS	8	550	8/12
North LaSalle Channel+	NLS	AVAS	4	550	8/11
Sheppard's Bay	SHP	AVAS	11	500	8/11
Sheppard's Bay*	SHP	PI	147	150, 350	8/13
Smith's Bay	SM	AVAS	6	550	8/11

*AVAS = Aquatic Vegetation Assessment Site Survey, PI = Point Intercept Survey, *Weevil Population Survey 8/12/14, +ELS and NLS included in the Cedarville Bay results (Section 3.1)*

2.0 Methods

Two vegetation survey methods were implemented throughout nine areas: an Aquatic Vegetation Assessment Site (AVAS) survey and a Point Intercept (PI) survey. A follow-up survey to the Milfoil Solution® program to evaluate the milfoil weevil was conducted in Cedarville Bay, Sheppard's Bay, and Smith's Bay following protocols established by EnviroScience.

2.1 Aquatic Vegetation Assessment Sites (AVAS) Survey Method

Qualitative vegetation sampling was performed using the Michigan DEQ guidance contained in Standard Procedures for Surveying Aquatic Plants. Survey areas were selected based on input from the LCWC and EnviroScience biologists. The boundary of each AVAS was determined using differential GPS technology. Plant community data were collected through visual and rake tow surveys along evenly-spaced transects of the littoral zone. In each of these transect zones, the presence and relative density of each aquatic plant species were determined and the information was recorded on the Standard Aquatic Vegetation Assessment Site Species Density Sheet developed by the State of Michigan. Visual and rake surveys were performed at each site

until no new species were encountered and the biologists conducting the survey were confident that adequate information had been obtained to estimate the density of each species encountered. Species of unknown identity were placed in a sample bag, appropriately labeled, and identified using taxonomic keys at the completion of the survey. The approximate percentage of cumulative cover (%CC) was reported as cover codes A, B, C, and D to describe the approximate coverage of each plant between each transect and within each AVAS. However, the cover code colors listed below are represented in the maps (App A, Figures 3.1-3.7) for Eurasian watermilfoil in each bay; if there is no color then simply there was no milfoil.

Cover Code and Map Color	Percent Cumulative Cover (%CC) Range
A	1-2%
B	3-20%
C	21-60%
D	61-100%

2.2 Point Intercept Survey Methods

A Point Intercept Survey (PI) was conducted in Cedarville Bay (CDB) and Sheppard's Bay (SHP) following methods outlined in Point Intercept and Line Intercept Methods for Aquatic Plant Management (Madsen, 1999). This survey method was chosen based on the relatively shallow depths and larger areas of both bays. A grid of evenly-spaced Point Intercepts was created using GPS technology and the surveyors navigated to each point along the grid. At each PI location, the presence and relative density of each aquatic plant species was determined by a single rake tow. Once the rake was retrieved from a point, each species found on the rake was identified and assigned a density code for rake cover similar to the AVAS method. As stated above, the density of EWM is represented in the maps for this particular survey. Species of questionable identity were identified at the completion of the survey.

2.3 Weevil Population Survey Methods

Survey methods developed by EnviroScience include qualitative and quantitative information to monitor changes occurring in both the weevil population and milfoil density over the course of time. Qualitative observations in these surveys included the general appearance and health of milfoil, identification of native plant species present, and the presence of weevils and weevil-induced damage. Quantitative measurements included milfoil density and weevil population density. Milfoil density was determined by using a 0.09 m^2 PVC quadrat, randomly tossing it throughout the milfoil bed, and counting the stems within the quadrat. This count was converted to the number of milfoil stems per square meter (stems/m^2). Weevil population density (the average number of weevils per stem) was determined through lab analysis of 30 stems collected randomly from each site.

3.0 Vegetation Survey (AVAS and PI)

In total 33 species were observed throughout the Les Cheneaux Islands in 2014 (see Table 3.0). The results below outline the results of the Point Intercept and AVAS surveys and make some comparisons to 2013 where possible.

Table 3.0 2014 Aquatic Plant Species List

Common Name	Species Name
Alternate watermilfoil	*Myriophyllum alterniflorum*
Bladderwort*	*Utricularia macrorhiza*
Blunt-leaf pondweed	*Potamogeton obtusifolius*
Bulrush	*Scirpus sp.*
Buttercup	*Ranunculus aquatilis*
Cattail (Narrow leaf)	*Typha angustifolia*
Chara	*Chara sp.*
Clasping-leaf pondweed	*Potamogeton richardsonii*
Coontail	*Ceratophyllum demersum*
Curly-leaf pondweed	*Potamogeton crispus*
Eelgrass	*Vallisneria americana*
Elodea	*Elodea canadensis*
Eurasian watermilfoil	*Myriophyllum spicatum*
Flatstem pondweed	*Potamogeton zosteriformis*
Floating-leaf pondweed	*Potamogeton natans*
Fries' pondweed	*Potamogeton friesii*
Illinois pondweed	*Potamogeton illinoensis*
Large-leaf pondweed	*Potamogeton amplifolius*
Marigold	*Bidens beckii*
Naiad	*Najas flexilis*
Nitella (common)	*Nitella sp.*
Nitella (uncommon)	*Nitella sp.*
Northern watermilfoil	*Myriophyllum sibiricum*
Quillwort	*Isoetes lacustris*
Robbins'/Fern pondweed	*Potamogeton robbinsii*
Spikerush	*Eleocharis acicularis*
Stiff pondweed	*Potamogeton strictifolius*
Thin-leaf pondweed	*Potamogeton pusillus*
Variable pondweed	*Potamogeton gramineus*
Water lobelia	*Lobelia dortmanna*
Water Stargrass	*Zosterella dubia*
Whorled watermilfoil	*Myriophyllum verticillatum*
Yellow water-lily	*Nuphar lutea*

*Only observed in milfoil stocking survey

3.1. Cedarville Bay (CDB)

To accommodate the large area in Cedarville Bay, both Point Intercept and AVAS survey methods were implemented. In addition, both East Lasalle Channel and North LaSalle Channel have been combined in the Cedarville Bay AVAS survey results.

Cedarville Bay Point Intercept Survey

The point intercept survey was conducted at 146 points within Cedarville Bay (see Figure 3.1.a. in Appendix A). In total, 21 species were observed in 2014 which was down from 25 species observed in 2013 (see Table 3.1.a). Milfoil was present at 45% of the sites (65 sites total) with varying densities, however the majority of which consisted of <3% cover. While none of the points consisted of dense milfoil growth, moderate and sparse growth were both observed at 5% of the sites respectively (see Table 3.1.a). Species with the highest occurrence across sites consisted of pondweeds (78%), macroalgae (68% of sites) and eelgrass (66% of sites). Other plants that were readily observed include naiad (39%) native milfoils (18%) and elodea (15%) (see Table 3.1.b).

Table 3.1.a: Comparison of Species Occurrence at PI Sites in Cedarville Bay between 2013-2014

Common Name	2013 Percent of Points (146)	2014 Percent of Points (146)	Common Name (continued)	2013 Percent of Points (146)	2014 Percent of Points (146)
Eelgrass	52	66	Coontail	3	2
Chara	59	53	Flatstem pondweed	6	1
Eurasian watermilfoil	**51**	**44**	Stiff pondweed	<1	1
Naiad	30	39	Thin-leaf pondweed	*	1
Robbins'/Fern pondweed	25	20	Alternate watermilfoil	<1	<1
Clasping-leaf pondweed	17	18	Nitella (uncommon)	*	<1
Northern watermilfoil	3	18	Water lobelia	<1	<1
Elodea	28	15	Blunt-leaf pondweed	3	*
Large-leaf pondweed	12	14	Bulrush	1	*
Nitella (common)	19	14	Pipewort	2	*
Illinois pondweed	16	12	Spadderdock	<1	*
Variable pondweed	8	7	Water Stargrass	8	*
Marigold	2	5	Whorled watermilfoil	10	*
Fries' pondweed	3	3			

** species not observed*

Table 3.1.b: Occurrence of Species' Groups at PI Sites in Cedarville Bay

Common Name (Grouped)	Total Occurrence	Percent of Points (146)
Pondweeds	114	78
Macroalgae	100	68
Eelgrass	97	66
Eurasian watermilfoil	65	45
Naiad	57	39
Native milfoils	27	18
Elodea	22	15
Marigold	7	5
Coontail	3	2
Water lobelia	1	<1

AVAS Survey

Three AVAS's were performed along the northwest portion of Cedarville Bay, while four surveys were performed in North LaSalle Channel and nine within East LaSalle Channel (see Figure 3. 1.c). In total, 19 species were observed throughout this section of LCI with eelgrass as the dominant species covering 16.55% CC. Although eelgrass was the most dominant species, as a group, pondweeds had a higher cumulative cover with 17.13% CC (see Table 3.1.d). EWM comprised 11.63% CC throughout the 16 transects and ranged from sparse to moderate where observed (see Table 3.1.c). This was in stark contrast to 2013 where milfoil comprised 40% CC. Macroalgae (9.31% CC) and elodea (6.00% CC) rounded out the plant community with all other groups comprising less than 2% cumulative cover.

Table 3.1.c: Percent Cumulative Cover of Species Present in Cedarville Bay AVAS

Common Name	% CC
Eelgrass	16.44
Eurasian watermilfoil	**11.63**
Chara	9.19
Robbin's Pondweed	6.69
Elodea	6.00
Large Leaf pondweed	4.00
Illinois pondweed	3.88
Clasping Leaf pondweed	1.69
Alternate watermilfoil	1.25
Naiad	1.19
Northern watermilfoil	0.56
Fries pondweed	0.38
Flatstem pondweed	0.25

Coontail	0.19
Blunt pondweed	0.13
Curly leaf pondweed	0.13
Marigold	0.13
Nitella	0.13
Buttercup	0.06

Table 3.1.d: Percent Cumulative Cover of Species' Groups in Cedarville Bay AVAS

Species (Grouped)	CC%
Pondweeds	17.13
Eelgrass	16.44
Eurasian watermilfoil	11.63
Macroalgae	9.31
Elodea	6.00
Native watermilfoils	1.81
Naiad	1.19
Coontail	0.19
Marigold	0.13
Buttercup	0.06

3.2 Hessel Harbor (HH)

AVAS Survey

One AVAS was performed at Hessel Harbor in 2014 with 8 species total observed with both Elodea and EWM comprising 40.00% of the cumulative cover (see Figure 3.2.a in Appendix A; and Table 3.2.a below). Pondweeds (12.00% CC) and Chara (10.00% CC) were also readily available, while the other species', buttercup and eelgrass comprised 1% of the cumulative cover (see Table 3.2.b).

Table 3.2.a: Percent Cumulative Cover of Species Present in Hessel Harbor AVAS

Common Name	CC%
Elodea	40.00
Eurasian watermilfoil	**40.00**
Chara	10.00
Flat-stem pondweed	10.00
Buttercup	1.00
Clasping-leaf pondweed	1.00
Eelgrass	1.00
Thin-leaf pondweed	1.00

Table 3.2.b: Percent Cumulative Cover of Species' Groups in Hessel Harbor AVAS

Species (grouped)	CC%
Elodea	40.00
Eurasian watermilfoil	**40.00**
Pondweeds	12.00
Chara	10.00
Buttercup	1.00
Eelgrass	1.00

3.3 Hill's Channel (HC)

AVAS Survey

Across the seven AVAS's at Hill's Channel, 15 species were observed with the majority consisting of pondweeds (40.29% CC), macroalgae (26.00% CC) and naiad (20.00% CC) (see Table 3.3.b). EWM only accounted for 2% cumulative cover, while eelgrass comprised 3.29% CC and all others consisted of less than 1% CC (see Table 3.3.a below and Figure 3.3.a in Appendix A).

Table 3.3.a: Percent Cumulative Cover of Species Present in Hill's Channel AVAS

Species (Common Name)	CC%
Chara	25.71
Naiad	20.00
Large-leaf pondweed	18.71
Variable pondweed	10.29
Clasping-leaf pondweed	7.86
Eelgrass	3.29
Robbins'/Fern pondweed	3.00
Eurasian watermilfoil	**2.00**
Illinois pondweed	0.29
Nitella	0.29
Northern watermilfoil	0.29
Blunt-leaf pondweed	0.14
Elodea	0.14
Water Lobelia	0.14
Whorled watermilfoil	0.14

Table 3.3.b: Percent Cumulative Cover of Species' Groups in Hill's Channel AVAS

Species (grouped)	CC%
Pondweeds	40.29
Macroalgae	26.00
Naiad	20.00
Eelgrass	3.29
Eurasian watermilfoil	**2.00**
Native watermilfoils	0.43
Elodea	0.14
Water Lobelia	0.14

3.4 Islington Channel (IC)

AVAS Survey

In total, 18 species were observed throughout the Islington Channel AVAS (See Table 3.4.a). Cumulative cover of EWM at Islington Channel decreased dramatically to 0.77% CC in 2014 (see Figure 3.4.a). The majority of the plant community was comprised of macroalgae (17.77% CC), eelgrass (12.46% CC), pondweeds (10.70% CC) and naiad (5.69% CC) with the remainder below 1% CC (see Table 3.4.b).

Table 3.4.a: Percent Cumulative Cover of Species Present in Islington Channel AVAS

Common Name	Scientific Name	CC%
Chara	*Chara sp.*	16.23
Eelgrass	*Vallisneria americana*	12.46
Naiad	*Najas flexilis*	5.69
Illinois pondweed	*Potamogeton illinoensis*	5.62
Clasping-leaf pondweed	*Potamogeton richardsonii*	1.77
Nitella	*Nitella sp.*	1.54
Robbins'/Fern pondweed	*Potamogeton robbinsii*	1.15
Large-leaf pondweed	*Potamogeton amplifolius*	1.00
Eurasian watermilfoil	***Myriophyllum spicatum***	**0.77**
Variable pondweed	*Potamogeton gramineus*	0.77
Elodea	*Elodea canadensis*	0.46
Fries' pondweed	*Potamogeton friesii*	0.23
Marigold	*Bidens beckii*	0.23
Coontail	*Ceratophyllum demersum*	0.15
Blunt-leaf pondweed	*Potamogeton obtusifolius*	0.08
Flat-stem pondweed	*Potamogeton zosteriformis*	0.08
Northern watermilfoil	*Myriophyllum sibiricum*	0.08

Quillwort	*Isoetes lacustris*	0.08

Table 3.4.b: Percent Cumulative Cover of Species' Groups in Islington Channel AVAS

Species (grouped)	CC%
Macroalgae	17.77
Eelgrass	12.46
Pondweeds	10.70
Naiad	5.69
Eurasian watermilfoil	**0.77**
Elodea	0.46
Marigold	0.23
Coontail	0.15
Native watermilfoils	0.08
Quillwort	0.08

3.5 Moscoe Bay (MOS)

AVAS Survey

EWM was not observed at Moscoe Bay during the 2014 AVAS (see Figure 3.5.a in Appendix A and Table 3.5.a below). The majority of the plant community consisted of pondweeds (30.52% CC) followed by macroalgae (7.88% CC), eelgrass (1.38% CC) and marigold (1.25% CC) with all other species comprising less than 1% CC (see Table 3.5.b).

Table 3.5.a: Percent Cumulative Cover of Species Present in Moscoe Bay AVAS

Common Name	Scientific Name	CC%
Robbins'/Fern pondweed	*Potamogeton robbinsii*	21.63
Chara	*Chara sp.*	7.88
Clasping-leaf pondweed	*Potamogeton richardsonii*	6.88
Eelgrass	*Vallisneria americana*	1.38
Illinois pondweed	*Potamogeton illinoensis*	1.38
Marigold	*Bidens beckii*	1.25
Elodea	*Elodea canadensis*	0.50
Northern watermilfoil	*Myriophyllum sibiricum*	0.50
Stiff pondweed	*Potamogeton strictifolius*	0.50
Whorled watermilfoil	*Myriophyllum verticillatum*	0.25
Fries' pondweed	*Potamogeton friesii*	0.13
Naiad	*Najas flexilis*	0.13
Spikerush	*Eleocharis acicularis*	0.13

Table 3.5.b: Percent Cumulative Cover of Species' Groups in Moscoe Bay AVAS

Species (grouped)	CC%
Pondweed	30.52
Macroalgae	7.88
Eelgrass	1.38
Marigold	1.25
Native watermilfoils	0.75
Elodea	0.50
Naiad	0.13
Spikerush	0.13

3.6 Sheppard's Bay (SHP)

Point Intercept Survey

A point intercept survey was implemented at 147 points in Sheppard's Bay in 2014 (see Figure 3.6.a. in Appendix A). In total, 19 species were observed in 2014 which was down from 21 species observed in 2013. Milfoil was present at 48% of the sites (71 total) with varying densities, however the majority of which consisted of <3% cover (see Table 3.6.a). While none of the points consisted of dense milfoil growth, moderate and sparse growth were both observed at 4% of the sites respectively Pondweeds as a combined group had the highest occurrence across sites followed by EWM, naiad (48%), eelgrass (45%) and macroalgae (43%). All other species were present at 3% of the sites or less (see Table 3.6.b).

Table 3.6.a: Comparison of Species Occurrence at PI Sites in Sheppard's Bay between 2013-2014

Common Name	2013 Percent of Points (146)	2014 Percent of Points (146)	Common Name (continued)	2013 Percent of Points (146)	2014 Percent of Points (146)
Naiad	41	48	Coontail	1	1
Eurasian watermilfoil	**79**	**48**	Stiff pondweed	<1	1
Eelgrass	48	45	Blunt-leaf pondweed	<1	<1
Chara	50	31	Floating-leaf pondweed	*	<1
Clasping-leaf pondweed	24	30	Northern watermilfoil	*	<1
Illinois pondweed	7	14	Yellow water-lily	*	<1
Nitella	1	10	Bulrush	3	*
Robbins'/Fern pondweed	7	9	Cattail (Narrow leaf)	<1	*
Variable pondweed	12	9	Flatstem pondweed	5	*

Fries' pondweed	<1	7
Large-leaf pondweed	*	4
Marigold	<1	3
Elodea	7	2
Thin-leaf pondweed	1	*
Water Stargrass	3	*
Whorled watermilfoil	3	*

** species not observed*

Table 3.6.b: Occurrence of Species' Groups at PI Sites at Sheppard's Bay in 2014

Common Name (Grouped)	Total Occurrence	Percent of Points (146)
Pondweeds	114	78
Macroalgae	100	68
Eelgrass	97	66
Eurasian watermilfoil	**65**	**45**
Naiad	57	39
Native milfoils	27	18
Elodea	22	15
Marigold	7	5
Coontail	3	2
Water lobelia	1	<1

AVAS Survey

Across the eleven AVAS's surveyed at Sheppard's Bay, 15 species were observed with the majority consisting of naiad (16.45% CC), pondweeds (10.81% CC), macroalgae (9.19% CC) and eelgrass (2.64% CC) (see Figure 3.6.b in Appendix A and Table 3.6.d below). EWM only accounted for 2.64% cumulative cover, while all others consisted of less than 1% CC (see Table 3.6.c.).

Table 3.6.c: Percent Cumulative Cover of Species Present in Sheppard's Bay AVAS

Common Name	Scientific Name	CC%
Naiad	*Najas flexilis*	16.45
Chara	*Chara sp.*	8.55
Eelgrass	*Vallisneria americana*	6.18
Clasping-leaf pondweed	*Potamogeton richardsonii*	5.82
Eurasian watermilfoil	***Myriophyllum spicatum***	**2.64**
Robbins'/Fern pondweed	*Potamogeton robbinsii*	2.18
Fries' pondweed	*Potamogeton friesii*	1.00
Flat-stem pondweed	*Potamogeton zosteriformis*	0.91
Nitella	*Nitella sp.*	0.64

Illinois pondweed	*Potamogeton illinoensis*	0.45
Variable pondweed	*Potamogeton gramineus*	0.45
Elodea	*Elodea canadensis*	0.36
Northern watermilfoil	*Myriophyllum sibiricum*	0.27
Marigold	*Bidens beckii*	0.18
Water stargrass	*Heteranthera dubia*	0.09

Table 3.6.d: Percent Cumulative Cover of Species' Groups in Sheppard's Bay AVAS

Species (grouped)	CC%
Naiad	16.45
Pondweeds	10.81
Macroalgae	9.19
Eelgrass	6.18
Eurasian watermilfoil	**2.64**
Elodea	0.36
Northern watermilfoil	0.27
Marigold	0.18
Water stargrass	0.09

3.7 Smith's Bay (SM)

In total, 15 species were present at Smith's Bay (see Table 3.7.a). EWM comprised 7.00% of the cumulative cover across the six AVAS transects. The dominant species present consisted of eelgrass (16.83% CC) with bulrush (13.50% CC), pondweeds (12.67% CC) making up the majority of the species (see Table 3.7.b). Other aquatic plants present include naiad (3.67% CC), macroalgae (2.50% CC), elodea (2.00% CC), native watermilfoils (0.67% CC) and water stargrass (0.17% CC).

Table 3.7.a: Percent Cumulative Cover of Species Present in Smith's Bay AVAS

Common Name	Scientific Name	CC%
Eelgrass	*Vallisneria americana*	16.83
Bulrush	*Scirpus sp.*	13.50
Large Leaf pondweed	*Potamogeton amplifolius*	8.50
Eurasian watermilfoil	***Myriophyllum spicatum***	**7.00**
Clasping Leaf pondweed	*Potamogeton richardsonii*	3.67
Naiad	*Najas flexilis*	3.67
Nitella	*Nitella sp.*	2.33
Elodea	*Elodea canadensis*	2.00

Alternate watermilfoil	*Myriophyllum alterniflorum*	0.33
Robbins'/Fern pondweed	*Potamogeton robbinsii*	0.33
Chara	*Chara sp.*	0.17
Northern watermilfoil	*Myriophyllum sibiricum*	0.17
Variable pondweed	*Potamogeton gramineus*	0.17
Water stargrass	*Heteranthera dubia*	0.17
Whorled watermilfoil	*Myriophyllum verticillatum*	0.17

Table 3.7.b: Percent Cumulative Cover of Species' Groups in Smith's Bay AVAS

Species (grouped)	CC%
Eelgrass	16.83
Bulrush	13.50
Pondweeds	12.67
Eurasian watermilfoil	**7.00**
Naiad	3.67
Macroalgae	2.50
Elodea	2.00
Native watermilfoils	0.67
Water Stargrass	0.17

4.0 Weevil Population Survey

Milfoil Solution® (formerly Middfoil®) utilizes a biocontrol agent, the milfoil weevil (*Euhrychiopsis lecontei*), for an invasive, exotic plant, Eurasian watermilfoil. This program was first implemented in two locations within Cedarville in 2007, stocking over 15,000 weevil eggs and larvae to an indigenous population. A dramatic reduction of EWM was observed for multiple years after this initial augmentation. In 2011, EnviroScience was contracted by Les Cheneaux Islands Watershed Council to supply the Milfoil Solution® program to various bays within Lake Huron as part of a Great Lakes Restoration Initiative Grant. A total of 86,000 weevil eggs and larvae were stocked within four areas (Table 4.0) in 2011 and 2012.

Table 4.0 Milfoil Solution® at Cedarville, Sheppard's, and Smith's Bays.

Bay	Year	Survey Dates	Sites – established and/or stocked	Number of Weevils Stocked
Cedarville Bay	2007	Initial: 6/21 Follow-up: 8/7	S1,S2, MonA	15,500
	2008	Follow-up: 8/6	Survey	0
	2009	Follow-up:8/11	Survey	0
	2011	Initial:8/5 Follow-up:9/12	S3, MonB	15,000
	2012	Initial: 6/27 Follow-up:8/30	S2, S3	12,000
	2013	Follow-up: 8/6	Survey	0
	2014	Follow-up: 8/12	Survey	0
Sheppard's Bay	2011	Initial:8/5	S1, MonA	30,000

		Follow-up:9/12		
	2012	Initial: 6/27 Follow-up: 8/30	S1	14,000
	2013	Follow-up: 8/6	Survey	0
	2014	Follow-up: 8/12	Survey	0
Smith's Bay	2011	Initial:8/5 Follow-up:9/12	S1, MonA	10,000
	2012	Initial: 6/27 Follow-up: 8/30	S1	5,000
	2013	Follow-up: 8/6	Survey	0
	2014	Follow-up: 8/12	Survey	0

4.1 Cedarville Bay

2007 Sites

S1 – EnviroScience biologists returned to the 2007 weevil stocking sites to perform a follow up survey on August 12, 2014. Milfoil at this site was sparse comprising 2% of the plant community with a density of 25.93 stems/m^2 (see Table 4.1.b). The milfoil bed consisted of scattered stems close to shore and were heavily damaged, similar to the 2013 season. Weevil damage was observed on 90% of the stems with weevils observed in all life stages. Weevil density at the time of the survey was 1.67 weevils/stem (see Table 4.1.a). This season, it appears that bulrush is extending out from shore with the plant well established throughout the site.

Native species recorded at this site include: bladderwort, bulrush, *Chara*, clasping pondweed, coontail, eelgrass, elodea, flat-stemmed pondweed, fries pondweed, marigold, naiad, *Nitella*, northern watermilfoil and stiff pondweed. Please note that bladderwort was only observed during the stocking survey and was not observed during the Point Intercept or AVAS surveys.

S2 – During the follow-up survey in 2014, milfoil at this site was sparse, comprising 5% of the plant community with a density of 22.22 stems/m^2 (see Table 4.1.b). Milfoil remained consistent with what was observed in 2013 with a sparse density. At the time of the survey, 60% of the stems were showing signs of larval damage with meristems falling off the plants. Weevils were observed in the adult, larval and egg life stages with a weevil density of 0.43 weevils/stem (see Table 4.1.a).

Native species observed include: bladderwort, *Chara*, clasping pondweed, eelgrass, elodea, flat-stemmed pondweed, Illinois pondweed, large-leaf pondweed, marigold, naiad and stiff pondweed. Marigold was the dominant species on site.

MA – This site was set up as a monitoring site in 2007 to compare to S1 and S2. Since 2013, milfoil at this site had decreased to 12.96 stems/m^2 and is sparse (see Table 4.1.b). Milfoil at this site was damaged with scattered stems located along the shore. Weevil damage was observed on 90% of the stems with weevils observed in the larval and pupal life stages. Weevil density at the time of the survey consisted of 0.07 weevil/stem (see Table 4.1.a). Similar to 2013, a small area within this site was tested with the fungi pathogen (*Mycoleptodiscus*

terrestris) by the LCWC. At the time of the survey, the stems within the area were in poor health and dying back.

Native species observed include: *Chara*, clasping-leaf pondweed, eelgrass, Illinois pondweed, marigold, naiad, *Nitella*, northern watermilfoil and stiff pondweed.

2011 Sites

S3 – Milfoil at S3 remained moderately dense with little change in milfoil density over the past three seasons. Milfoil density at the time of the survey consisted of 75.93 stems/m^2 (see Table 4.1.b). At the time of the survey, milfoil was beginning to auto-fragment with most stems bent over due to water current. Weevils were not observed at the site during visual surveys, however, one pupae was observed in samples collected to determine weevil density. Weevil density at the time of the survey was 0.03 weevil/stem, similar to 2013 (see Table 4.1.a).

Native species present during the survey include: clasping-leaf pondweed, eelgrass, elodea, Illinois pondweed and large-leaf pondweed.

MB –Milfoil at this site was moderately dense and comprised 95% of the plant community. Milfoil density was roughly double what was observed in 2013 at 79.37 stems/m^2 (see Table 4.1.b). At the time of the survey, milfoil was auto-fragmenting. Weevils were not observed at this site or in samples collected to determine weevil density. Native species present included eelgrass and clasping-leaf pondweed.

Table 4.1.a Weevil Population Density in Cedarville Bay

Site	Parameter measured	6/22/07	8/7/07	8/6/08	8/11/09	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	Total weevils	8.00	11.00	9.00	21.00	8.00	1.00	0.00	2.00	36.00	50.00
	Total stems	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	**0.27**	**0.37**	**0.30**	**0.70**	**0.27**	**0.03**	**0.00**	**0.67**	**1.20**	**1.67**
S2	Total weevils	16.00	7.00	0.00	11.00	0.00	0.00	0.00	2.00	25.00	13.00
	Total stems	30.00	30.00	28.00	30.00	10.00	29.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	**0.53**	**0.23**	**0.00**	**0.37**	**0.00**	**0.00**	**0.00**	**0.67**	**0.83**	**0.43**
S3	Total weevils					0.00	0.00	0.00	0.00	1.00	1.00
	Total stems	*	*	*	*	30.00	30.00	29.00	30.00	30.00	30.00
	Avg. weevils/stem					**0.00**	**0.00**	**0.00**	**0.00**	**0.03**	**0.03**
MA	Total weevils	2.00	9.00	1.00	8.00	3.00	0.00	0.00	1.00	16.00	2.00
	Total stems	30.00	30.00	28.00	30.00	30.00	29.00	28.00	30.00	30.00	27.00
	Avg. weevils/stem	**0.07**	**0.30**	**0.036**	**0.27**	**0.10**	**0.00**	**0.00**	**0.03**	**0.53**	**0.07**
MB	Total weevils						0.00	0.00	0.00	0.00	0.00
	Total stems	*	*	*	*	*	30.00	30.00	30.00	30.00	29.00
	Avg. weevils/stem						**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

** = site not established*

Table 4.1.b Average Density of EWM (stems/m^2) in Cedarville Bay

Site	6/22/07	8/7/07	8/6/08	8/11/09	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	244.44	211.11	11.11	25.89	51.9	<10	50	120.37	15.87	25.93
S2	300.00	166.67	40.00	0.00	<10	<10	72.22	174.07	20.37	22.22

S3	*	*	*	*	77.8	163.0	83.33	88.89	70.37	75.93
MA	155.55	270.00	133.33	74.11	66.7	63.0	157.41	125.93	38.89	12.96
MB	*	*	*	*	*	144.4	62.96	81.48	42.59	79.37

** = site not established*

4.2 Sheppard's Bay

S1 – This site was not surveyed in 2014 due to a lack of milfoil available during the time of the site visit. In total five stems of milfoil were observed and were blackened and senescing. Stems were not available for analysis. In addition, pathogen experiments using *Mycoleptodiscus terrestris* were also performed in the northern part of Sheppard's Bay. ES biologists swam through this area of milfoil that the experiment was taking place and identified extensive larval damage.

Native species present consisted of clasping-leaf pondweed, eelgrass, Illinois pondweed, marigold, naiad, northern watermilfoil and Robbin's pondweed.

MA – Milfoil at this site comprised 40% of the plant community at the time of the survey with a density of 35.19 stems/m^2 (see Table 4.2.b). Milfoil density decreased by roughly half of what was observed in 2013 at this site. Roughly 10% of the milfoil showed signs of larval damage with weevils observed in the larval life stage during visual inspection at the site. Weevils were not observed in samples collected to determine weevil density.

Native species present included: *Chara*, clasping-leaf pondweed, eelgrass, elodea, Illinois pondweed, marigold, naiad, *Nitella* and Robbin's pondweed.

Table 4.2.a Weevil Population Density in Sheppard's Bay

Site	Parameter measured	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	Total weevils	0.00	0.00	0.00	2.00	0.00	
	Total stems	30.00	60.00	60.00	58.00	30.00	**
	Avg. weevils/stem	**0.00**	**0.00**	**0.00**	**0.07**	**0.00**	
MA	Total weevils	5.00	0.00	3.00	1.00	8.00	0.00
	Total stems	30.00	30.00	30.00	30.00	30.00	30.00
	Avg. weevils/stem	**0.17**	**0.00**	**0.10**	**0.03**	**0.27**	**0.00**

**= EWM absent

Table 4.2.b Average Density of EWM (stems/m^2) in Sheppard's Bay

Site	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	74.1	211.1	105.56	195.30	55.56	**
MA	37.0	31.5	70.37	183.33	64.81	35.19

**=EWM absent

4.3 Smith's Bay

S1 – Milfoil at S1 has consistently decreased in density by the late-season surveys since being stocked in 2011. Milfoil at this site comprised 35% of the plant community and was moderate to sparse with 33.33 stems/m^2 (see Table 4.3.b). Roughly 50% of the stems showed signs of larval damage at the time of the survey. Weevils were observed in the adult, larval and pupal life stages. Weevil density was the highest in 2014 with 0.40 weevils/stem (see Table 4.3.a).

Native species observed include: *Chara*, clasping-leaf pondweed, eelgrass, elodea, fries pondweed, marigold, naiad and northern watermilfoil.

MA – Milfoil at MA reduced dramatically in 2014 to 14.81 stems/m^2 comprising 10% of the plant community (see Table 4.3.b). Weevil damage was not observed on the plants, however weevils were observed in the adult and larval life stages in samples collected to determine weevil density. Weevil density at the time of the survey was 0.10 weevils/stem (see Table 4.3.a).

Native species observed at this site include: *Chara*, clasping-leaf pondweed, eelgrass, elodea, large-leaf pondweed, northern watermilfoil and variable leaf pondweed.

Table 4.3.a Weevil Population Density in Smith's Bay

Site	Parameter measured	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	Total weevils	5.00	2.00	13.00	1.00	6.00	12.00
	Total stems	30.00	30.00	60.00	60.00	30.00	30.00
	Avg. weevils/stem	**0.17**	**0.07**	**0.22**	**0.02**	**0.20**	**0.40**
MA	Total weevils	*	0.00	13.00	0.00	6.00	3.00
	Total stems		30.00	29.00	30.00	29.00	29.00
	Avg. weevils/stem		**0.00**	**0.45**	**0.00**	**0.21**	**0.10**

* = site not established

Table 4.3.b Average Density of EWM (stems/m^2) in Smith's Bay

Site	8/5/11	9/12/11	6/27/12	8/30/12	8/6/13	8/12/14
S1	137.0	113.9	209.26	235.19	19.05	33.33
MA	*	85.2	77.78	83.33	64.81	14.81

** = site not established*

5.0 Discussion

5.1 Plant Survey

As observed in 2013, the Les Cheneaux Islands contain a very diverse aquatic plant community. In total 29 beneficial native species and three invasives were observed in the 2014 survey. While this number of total observed species is lower than 2013, it is important to note that theses AVAS surveys were performed in different locations than 2013 with less sites overall. Throughout both Point Intercept Surveys and AVAS Surveys performed at LCI, the most noticeable difference was the decrease in the overall amount of EWM. In 2014, Hessel Harbor was the only location surveyed where EWM was the dominant species present, however shared this dominance with elodea (40% C.C. each). EWM was present throughout all bays and channels surveyed with exception to Moscoe Bay. However, EWM made up only 2% of the

cumulative cover or less in AVAS surveys at Cedarville Bay, Hill's Channel and Islington Channel.

This overall decrease in EWM presence observed in 2014 is very promising, especially since increases in EWM occurred in 2011 and 2012. This decline in EWM dominance is well illustrated in the Milfoil Density in Les Cheneaux Islands figure comparing both Point Intercept surveys (Cedarville Bay and Sheppard's Bay) across 2013 and 2014 (see Appendix A). This figure clearly shows the decline in EWM dominant sites throughout the two bays. Most notably is the complete collapse of dense EWM throughout the center of Sheppard's Bay between 2013 and 2014 within the immediate location of the stocking sites, S1 (this collapse will be discussed in more detail under Section 5.2). In addition, the majority of the points surveyed throughout 2014 consist of 2% EWM cover or less with only one point observed over 60% cover across the two bays.

Along with this decrease in EWM, species composition throughout all sites surveyed appeared to be very diverse. Rather than one dominant species observed throughout LCI, each channel and bay appeared to have a unique species composition. When comparing AVAS surveys, sections such as East Lasalle Channel and Islington Channel were dominated by the macroalgae, *Chara*, while other sections were dominated by pondweeds (Hill's Channel, Moscoe Bay), elodea (Cedarville Bay), eelgrass (Smith's Bay), naiad (Sheppard's Bay), etc. Diversity of species and species composition is an important component to successful competition with invasives such as EWM.

As discussed in the 2013 report, a healthy and diverse native aquatic plant community provides essential habitat structure for fish and other organisms. These plants provide cover, foraging and spawning habitat and is an essential part of a healthy aquatic food web. In addition, native aquatic plants can influence healthy nutrient cycling, stabilize banks, oxygenate water and can compete with aggressive invasive species such as EWM.

In addition to EWM, other invasive aquatic plant species observed included narrow-leafed cattail and curly-leaf pondweed. Consistent with 2013, narrow-leafed cattail was positively identified along the Hill's Channel shoreline this season. Several invasive species such as *Phragmites*, reed canary grass and purple loosestrife were also observed in 2013 but not observed in 2014. This does not mean they were not present, however these emergent species were not sampled in our point intercepts and AVAS surveys. The exotic-invasive, curly-leaf pondweed was observed within Cedarville Bay during the 2014 AVAS survey. This invasive species is very common throughout the Great Lakes Watershed and has become widespread across North America since its introduction in the mid-1800's. Curly-leaf pondweed is a cold tolerant species that has been known to actively grow in winter months. This species can be introduced by fragments or turions (winter bud) given off by the plant. Once established, curly-leaf pondweed grows quickly in the spring and mats at the surface of the water in the early growing season. This matting is typically followed by a mid-summer die-off, and in turn, can decrease oxygen levels due to decomposition. In Cedarville Bay, curly-leaf pondweed only accounted for 0.33% cumulative cover and would not be considered an immediate concern for LCI. In actuality, it is

possible that curly-leaf has been present but previously undetected in LCI since this species is commonly found throughout the Great Lakes Basin. Continued monitoring would be recommended to ensure this species does not become an issue.

Overall, the results of the 2014 Point Intercept and AVAS surveys are very promising. In addition to noticeable decreases in EWM dominance, LCI continues to have a very diverse and vibrant native plant community. These diverse communities allow the opportunity for native species to compete for space and dominance with invasive species that create a nuisance. Continued management strategies should take into account the preservation of desirable and sensitive species as well as overall ecosystem health while focusing on control of nuisance species.

5.2 Weevil Survey

Throughout the 2014 season, we have observed several positive results for the milfoil weevil stocking program. These positive changes include the complete collapse of S1 at Sheppard's Bay, high weevil density at Cedarville Bay (S1 and S2) and Smith's Bay (S1), and low EWM density throughout all three bays. These types of results are consistent with successful weevil stocking programs.

The most notable change observed is the collapse of the EWM bed observed at S1 in Sheppard's Bay which led to the inability to survey the site due to a lack of EWM. Only a handful of stems were observed at the site and consisted of blackened and dying back EWM. This collapse follows drastic changes observed between the 2012 and 2013 survey and was considered one of the largest changes noted in the 2013 report.

While not as drastic, S1 and S2 at Cedarville Bay have shown a consistent decrease and suppression of nuisance EWM growth. Although the progress has not been as rapid as the initial weevil stocking in Cedarville Bay in 2007, EWM density has shown a steady decrease since 2012. Even with excessive EWM growth observed throughout the 2012 season that occurred state-wide, EWM at Cedarville Bay remained well below initial densities in 2007. In addition to decreases in overall EWM density, these sites also have healthy weevil populations with weevil density increasing at S1 since 2011 to the highest density observed at the site in 2014 (1.67 weevils/stem).

Since 2011, Smith's Bay has also showed similar and continual progress. Following dense EWM observed at the end of 2012, a major decline in EWM density has been observed at S1 by 2013. Although EWM density was slightly higher in 2014, EWM only comprised 35% of the plant community. Similar to Cedarville Bay, weevil density has been increasing at this site over the past three seasons.

Unlike the first two stocking sites at Cedarville Bay, S3 has seen little progress since stocking in 2011. Following the first season of stocking, EWM density has stabilized at roughly the ~70-80 stems/m^2 range. In addition, weevil presence has remained low throughout the duration of the program. It is not uncommon for sites to respond to stocking with minimal change, even while

other sites are showing declines in EWM and increases in weevil density. It would be difficult to say what environmental factors are limiting progress at this site (local site conditions, weevil dispersal, etc), however, it is apparent that EWM density has consistently remained half of what was observed during the 2011 late-season survey at this site.

Overall, the response to weevil stocking throughout the duration of the program has been positive. We have seen an overall decrease in the amount of nuisance EWM populations and an increase in the amount of weevils present. Additionally, all sites survey consisted of a diverse native plant community that will continue to compete for space with this aggressive invader. In addition, successful response to stocking has likely influenced the change in species composition in the surrounding plant community.

6.0 Recommendations

While EWM has been spreading rapidly throughout the Les Cheneaux Watershed for more than twenty years, 2014 gave some reprise from nuisance populations of this invader. Although the results of this survey are positive, continued monitoring is the best approach to dealing with nuisance species. Effective annual or biannual monitoring allows the opportunity to make future management decisions prior to aggressive species becoming a major issue. In addition, these surveys allow continued monitoring of other potential invaders that have the ability to become a nuisance. A good example is the presence of curly-leaf pondweed in 2014. This species has the ability to be a nuisance and was not observed in previous years, however it was discussed in the 2013 report as a potential concern. Our current recommendation for LCI is to continue monitoring the aquatic plant community to strategically prepare future management decisions.

7.0 Literature Cited

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